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# United States Patent [19]

Wu

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[54] **METHOD TO FORM MOSFET WITH AN INVERSE T-SHAPED AIR-GAP GATE STRUCTURE**

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[52] **U.S. Cl.** ..... **438/291**; 438/305; 438/592

[58] **Field of Search** ..... 438/291, 305, 438/307, 303, 592, 289

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[57] **ABSTRACT**

A method for fabricating a MOS transistor with an inverse T-shaped air-gap gate structure on a semiconductor substrate is disclosed. The T-shaped air-gap gate structure reduces the parasitic resistance and capacitance; hence device structure operation speed can be improved. The method comprises the following steps: firstly, a gate hollow is defined in the pad oxide/nitride layer. Next an ultra-thin nitrogen rich dielectric as a gate oxide is formed. After that, a thin α-Si is deposited, then an ion implantation is done to form a punchthrough stopping region. After forming a CVD oxide film, an anisotropic etching is followed to form oxide spacers. An undoped silicon layer then followed to refill the gate hollow region. A CMP processes or a dry etching is done to remove silicon layer until the nitride layer is exposed. Subsequently, the oxide spacers is removed to expose a dual hollow. A LDD implantation is then implanted into the substrate. Next a pad nitride/oxide layer is successive removed to expose the substrate by a dry etching method. Subsequently, a source/drain/gate implantation and a hight temperature oxidation are carried out to grow an oxide layer and seal the dual hollow so as to form a dual air gap. At the same time the extended S/D junction are formed.

**16 Claims, 5 Drawing Sheets**